H. G. FISCHER & CO.

Manufacturers

X-ray and Electromedical Equipment

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(SUBURB OF CHICAGO)

SIMPLIFIED MANUAL

OF

X-RAY TECHNIC

FOREWORD

This manual of Medical x-ray technic and related data has been prepared by the X-ray Field Service Department of H. G. FISCHER & CO. and is presented to you with their compliments.

It is not intended to be a complete treatise on radiographic technic, but consists of an accumulation of papers or sets of papers containing general practical information on the subject.

The entire purpose of the manual is to give you, in condensed form, material of a nature that we believe will have the effect of improving radiographic end results and consequently the accuracy of a diagnosis.

Special attention has been paid to positioning and we hope that the positioning information, both written and photographic, will be of value to you.

H. G. FISCHER & CO. are vitally interested in every Fischer installation and you are cordially invited to call upon them at any time for helpful technical suggestions.

H. G. FISCHER & CO.

RECOMMENDED PROCEDURE FOR ADJUSTING AND SETTING UP EQUIPMENT FOR RADIOGRAPHIC WORK

Experience has proven that if a routine procedure is followed when making a radiograph, many mistakes and omissions will be eliminated with the resulting economy in film.

While experienced operators will have their own ideas of radiographic procedure, it is recommended that operators with little or no experience follow the step by step routine outlined below.

1. After determining what anatomical part is to be radiographed, refer to the technic chart furnished, which shows all the technical factors that will be used, such as milliamperes, kilovoltage, distance and time. The chart will also show if the Bucky diaphram is to be used. All factors that can be preset should be adjusted before the patient is placed on the table.

2. If high milliampere values are to be used (50 MA or more) the tube should be prewarmed. Prewarming of the tube before using high milliampere values will increase tube life. A machine setting of 5 milliamperes, 85 kilovolts, and 10 second time is sufficient to prewarm the x-ray tube. If the x-ray tube has been used within the past two hours, prewarming of the x-ray tube is not necessary.

3. If the machine has an automatic control, place milliampere selector switch on milliampere value shown on technic chart. If the control is of the manual type, set milliamperes by means of the main and auxiliary filament controls.

4. If control has a line compensator, adjust line compensator switch so that line compensator meter reads on red line.

5. If bucky is to be used, place timer switch in bucky timer position. If bucky is not used, place timer switch in timer position. Adjust timer for time factor shown on chart.

6. If bucky is used set timing device on Bucky diaphragm for approximately 20% more time than the actual time of exposure. Cock bucky by pulling Cocking handle all the way out.

7. If Bucky is used, make certain that the x-ray tube is centered on the table.

8. Adjust x-ray tube for correct height as indicated on the chart.

9. Place patient on the x-ray table making certain that the patient is centered on the table.

10. Measure patient with centimeter thickness caliper and set kilovoltage according to the chart.

11. Place cassette in bucky tray and position bucky so that part to be radiographed is centered on the cassette.

12. Center x-ray tube on cassette in Bucky diaphragm.

13. If compression band is to be used, place compression band in place and tighten lightly.

14. Double check all procedure such as line compensator, milliampere selector, kilovoltage, timer and timer switch, bucky timing, bucky cocking and height.

15. Tighten compression band if used.

16. Press timer push button. If Bucky diaphragm is used, it is only necessary to depress timer button for about 1/4 second. If bucky is not used and timer switch is set in timer position, it is necessary to hold timer push button down until timer automatically cuts off.

SPECIAL NOTES

1. Always prewarm cold tube when using high MA values.

2. On manual controls when using high MA values, always test milliampere setting at a kilovoltage 20 KV below the voltage value being used.

3. Longer tube life will follow if machine is turned off while positioning patient or changing patients.

4. Always use as small a cone as possible and still cover anatomical area to be radiographed.

5. Grasp compression band with hand and release slowly to eliminate injury to patient by the sudden release of the pressure.

6. Always keep loaded cassette in protective film chest until ready to make radiograph.

7. If red position of heat indicator shows on tube, further use must stop until tube cools off and heat indicator goes down.

8. Testing of MA values on manual controls should be done as rapidly as possible as time consumed in testing is the same as in actual exposure.

9. Consult tube loading chart for safe operation of tube.

As a guide in determining the safe exposure factors consult the enclosed table of maximum permissible exposure value in milliampere seconds. Milliampere seconds are the product of milliamperes and total actual exposure time in seconds. In using this table the maximum permissible exposure time in seconds is obtained by dividing the milliamperes used into the value of milliampere seconds permissible, for example, if the milliampere seconds used are five and the permissible exposure value in milliampere seconds total 1000 at a given filtration and distance, the milliamperage five (5) is divided into the milliamperage seconds 1000 which gives the time 200 seconds. This figure constitutes the maximum exposure time permissible.

MAXIMUM EXPOSURE FACTORS PERMISSIBLE FOR ALL PARTS OF THE BODY EXCEPT HEAD WHEN USING 85 KILOVOLTS PEAK

FACTORS APPLY TO BOTH RADIOGRAPHY AND FLUOROSCOPY

Anode Skin Distance Inches	Aluminum filter .5 MM inherent .5 MM external Permissible Milliampere second Exposure
10"	510 MAS
12"	730 MAS
14"	1000 MAS
16"	1300 MAS
18"	1650 MAS
20"	2050 MAS
22"	2450 MAS
24"	2900 MAS
30"	4500 MAS
36"	6500 MAS
42"	8850 MAS
48"	11600 MAS
60"	18000 MAS
72"	26000 MAS

CAUTION When radiographing the head, reduce above milliampere second factors 30%.

VARIATION IN MAXIMUM PERMISSIBLE EXPOSURE VALUES WITH CHANGE IN KILOVOLTAGE

Kilovolts	Change in permissible exposure values
100 KVP	Reduce by 25%
90 KVP	Reduce by 8%
85 KVP	No change
80 KVP	Increase by 10%
70 KVP	Increase by 35%
60 KVP	Increase by 80%

NOTE Milliampere seconds - Milliamperes X Time in seconds.

Example: 100 Milliamperes 1 second = 100 MAS
50 Milliamperes 2 seconds= 100 MAS
25 Milliamperes 4 seconds= 100 MAS
10 Milliamperes 10 seconds= 100 MAS
5 Milliamperes 20 seconds= 100 MAS

GENERAL DARK ROOM INFORMATION

Too much stress cannot be laid on the importance of the processing room construction and technical procedures, whether it be for private practice or a large institution. It is to be realized that the quality of the end result depends entirely on the facilities and the procedure used.

No radiograph is complete until it has passed through the developing process. Experience proves that even with the best radiographic equipment and accessories, radiographic technic can be made mediocre by faulty processing room service. Yet it is doubtful if ten percent of film processing laboratories the world over are on a par with the rest of the x-ray department in point of facilities to handle the work. Most laboratories are handicapped because the equipment in the processing room and the haphazard procedures used are inadequate.

LOCATION OF PROCESSING ROOM

An important consideration when planning a dark room is its location. First it must be within a reasonable distance from the x-ray machine. Second, it must be convenient to plumbing and electrical connections. Another important factor is ventilation.

CONSTRUCTION OF PROCESSING ROOM

Construction of processing room with reference to materials used is limited. It must be of such material as to preclude leakage of ordinary light and x-ray if unexposed films are to be stored in the dark room. The size of the dark room is determined by the nature and average amount of work that is to be handled. The minimum dimension should still allow room for convenient and efficient processing procedures. If considerable work is to be handled mazes are generally used which permits entering and leaving the dark room without the necessity of opening and closing doors.

COLOR TREATMENTS OF WALLS

In respect to the color treatment of the walls of the processing room, it is apparent there is much misunderstanding. Most x-ray laboratories utilize either black or some other dark pigment which is not necessary. The problem of color selection for the dark room is not important if the dark room is light proof. If a maze is used in conjunction with the dark room, the maze should be painted a dull dark color so that daylight or white light will be absorbed before it enters the dark room.

In many cases an acid and alkali proof paint is used around the developing tank. This should be a paint which is uneffected by acid or alkali and can be readily washed.

ACCESSORY EQUIPMENT

The following equipment is necessary in the dark room.

1. Safe lights.
2. Storage shelves or cabinets.
3. Loading bench.
4. Racks for developing hangers.
5. Developing tank.
6. Water temperature control, either manual or automatic.

7. Thermometer. Be sure to use a thermometer that is designed for developing purposes and which is accurate around 70 degrees Fahrenheit.
8. Developing timer.
9. Drying equipment, either film dryers or racks to hold the films while they are drying.

10. In large installations, a pass box between the radiographic room and the dark room.

ILLUMINATION

Safe lights cause a large percentage of processing room trouble. Fogging of the x-ray film is a phenomenon which the average operator may find difficult to trace to its source, that is to determine whether it is caused by the safelight, x-ray, or a chemical reaction. It is well to remember that there is no such thing as a safe light in the strict sense of the word. All safelights will fog sensitize emulsions by excessive exposure. Thus the problem of film exposure to light is an important one.

In the final analysis, the maximum amount of light intensity or wattage that may be used in the safelight is determined by the following four factors:
1. Location of safelight. That is, safelight to film distance.
2. Safelight filtration or the quality of light allowed to pass through the light filter.
3. Speed of placing the film in hanger.
4. Speed of operation while observing stage of development and rinsing film and placing it in the fixer or hypo solution.

It is apparent from the foregoing, the intensity or wattage of the bulbs used in dark room safelights is dependent upon the speed of the operator when processing a film.

STORAGE FACILITIES

Storage shelves should be of such size as to allow the housing of all sizes of films, cassettes and supplies. If a storage cabinet is used where the covers of the film box are removed, the storage cabinet should be equipped with limit or safety switches which will automatically put out all lights in the dark room with the exception of the safelights, should the storage chest or box be opened accidentally when the white lights are on.

LOADING FACILITIES

The loading bench should be of size which would allow the opening of film packages and loading of cassettes conveniently. The loading bench should always be kept clean as any form of contamination may not only ruin the film to a point where diagnosis is impossible, but also damage the intensifying screen. The loading bench should be situated away from the developing tank so that the developer and hypo will not be accidently spilled on the screens.

FILM HANGERS

Film hangers are an important item in the processing room procedure. They should be stored in a convenient location where they can be readily reached for loading of films for developing. They must be kept clean and should be thoroughly washed. This can be accomplished while washing the film provided the water in the washing tank covers the cross bar on the hanger. The flexible arms at the top of the developing frame should be adjusted so that the film is held taut in the

frame, thus eliminating a possibility of the film touching an adjacent film or the side of the tank which will cause an undeveloped area.

TANKS

Tanks for developing, rinsing and fixing should be of a size and capacity to meet the requirements of the individual laboratory. It should be capable of maintaining temperatures and be durable with a mininum reaction to chemicals. Many tank combinations are available the sizes and combinations depending entirely upon the amount of work to be done.

WATER TEMPERATURE CONTROL

Inasmuch as the temperature of the developing and fixing solutions are controlled by the rinse and washing water in the water compartment, it is necessary that some control be available for controlling the temperature of the water. In some installations it is merely necessary to have a hot and cold water valve which will permit adjusting the temperature of the water to the correct value. Other installations use thermostatic mixing valves whereby the temperature of the water is automatically controlled. In hot humid climates, very often it is necessary to use a refrigerated tank.

THERMOMETER

The dark room thermometer should be large enough so that its calibration can be read with accuracy when only the dark room lights are on. The dark room thermometer should not be housed in wood for this not only causes error in readings but also causes it to absorb chemicals. Over a period of time this will cause contamination of the solution. To avoid scratches the thermometer should not be allowed to come in contact with the films.

TIMER

A reliable timer is an indispensable item for accurate timing the intervals required in film processing. It should be sturdy and accurate and with a range sufficient to allow the maximum developing time and with a means of signaling when the interval is concluded.

DRYING EQUIPMENT

There are many forms of drying equipment and the type selected will of course depend on the amount of work that the laboratory is doing. Dryers can be obtained which are just ordinary racks where the film is allowed to drain and dry naturally. Other film dryers use forced draft and in some cases heat in order to dry the films quickly. Film dryers are available which not only can be used as film dryers but also as loading benches.

PASS BOX

In large laboratories the use of a pass box between the dark room and the radiographic room is a great convenience. Pass boxes are so designed that if the door on the radiographic room is open the door on the dark room side cannot be opened. This eliminates the possibility of white light entering the darkroom accidentally.

LOADING OF FILMS

When removing a film for loading in a cardboard holder the black paper which encloses the film should not be removed but placed with the film in the holder. This minimizes the possibility of fogging the film. When loading a cassette, however, the operator must be sure to let the paper fall away from the film. This is accomplished by taking the film out with the right hand, separating the film from the paper with the left hand and then allowing the paper to fall away from the film, thus minimizing friction and static. If there is difficulty in replacing the cover on the film carton, the sides should be pressed inward. This releases the air and allows the cover to fall into place.

DEVELOPING AND FIXING

The developing and fixing solution unless used at par strength and according to prescribed time and temperature are possible causes of more dark room trouble than any other factors. Temperature is very important in developing an x-ray film. As the temperature is raised the alkali works faster and as the temperature lowers it is retarded. The operator should consult the recommended developing time which will be found on the label of the developing container. It is also recommended that the developer manufactured by the film manufacturer be used.

Many operators make the mistake of trying to stretch out the life of their developer. This usually will cause a poor grade of radiograph with a decided falling off of the diagnostic qualities, and in the end it is poor economy as films are bound to be ruined and inasmuch as the developer is much cheaper than films it is advantageous to discard the developer before it reaches the point where it will affect the quality of the film.

THE FIXING PROCESS

A hypo solution which is used for fixing must do two things to the emulsion of the film. First, it must stop development and must free the emulsion from all unexposed or unreduced silver salts. Second, it must preserve or tan the emulsion to prevent deterioration. The greater percentage of an emulsion is gelatin and being animal matter it will decompose and deteriorate if not properly treated. The question of how long a film should be fixed is often brought up. A safe rule is to fix twice as long as it takes for the unreduced silver (seen as a yellow creamy substance) to disappear from the film.

LIFE OF DEVELOPING SOLUTION

The developing solution may become exhausted from age rather than from use. However, it is simple to determine the efficiency of the solution by checking the quality of the radiograph developed in it. The first sign of age in a developing solution is discoloration. It will gradually turn yellow and continue to turn dark brown. Developer in such a condition may produce stains and fog and obliterate the contrast that might be otherwise on the film.

LIFE OF THE FIXING SOLUTION

Hypo does not deteriorate rapidly unless films are processed through it. The length of time required to completely fix a film is a reliable check on the strength of the hypo. If it requires more than four times as long to fix a film as when the hypo is new and at the same temperature, it should be replaced.

PREPARATION OF SOLUTION

When mixing new solutions, it is important that the tanks be thoroughly scrubbed. If this is not done, some of the old chemicals will be mixed in with the fresh and the process of oxidation will be set up at once and shorten the life of the new chemicals.

QUESTIONS AND ANSWERS ON DARK ROOM TECHNIC

Question: What is the most important factor in designing a dark room?
Answer: The dark room must be what the name implies. Absolutely dark. Even a small pinhole of light will effect the film.

Question: Should the dark room walls be painted black?
Answer: If the room is light proof, the color makes no difference. Black walls are less apt to reflect light that leaks in around doors, etc.

Question: Can a window in the dark room be painted black to keep out the daylight?
Answer: Paint as a rule is unsatisfactory as it develops pinholes. It is much better to cover the window with some light opaque material.

Question: What is the most common cause of fogging films?
Answer: Faulty dark room lights. All dark room lights will fog the film if exposed to the light long enough. However, a good dark room light will not fog the film in the ordinary time required to process the film.

Question: Is the wattage of the bulb used in the dark room light important?
Answer: Very important. Never use a larger lamp bulb than that recommended by the manufacturer. (Usually 15 watts)

Question: How can the dark room light be tested?
Answer: Take a fresh film without any x-ray exposure on it and cover half of the film with the black paper it is wrapped in. Place the film about three feet from the dark room light and expose it for three minutes. Develop in the regular way and at the correct time for the temperature of the developer. If the light is fogging, the half of the film which was not covered will show fog.

Question: What kind of developer should be used?
Answer: It is recommended that developer made by the company making the film be used.

Question: Should regular or rapid developer be used?
Answer: Either regular or rapid developer can be used. However, if rapid developer is used, the speed of the developer can be maintained by the addition of replenisher.

Question: How often should developer be changed?
Answer: That depends upon how many films are developed and how large the tank is. Developer will exhaust itself without any use in about two or three months. Developer should be changed at least every sixty days.

Question: Should films be developed by sight or time?
Answer: If the exposure technic is correct, time development is more satisfactory.

Question: How long should a correctly exposed film be developed?
Answer: That depends upon the temperature. The warmer the developer, the shorter the developing time. Follow the timing directions on the container.

Question: Should the film be completely drained of developer when removing the film from the developing tank?
Answer: No. The film should be drained for about three seconds. Further draining only drains back into the tank exhausted developer which has been in close contact with the film. Operators should figure on using 1 oz. of developer for each 8 x 10 film, 3-1/2 oz. for each 14 x 17 film, and 7 oz. for each 14 x 36 film.

Question: How long should the film be washed after removing film from the developer?
Answer: About five or six seconds. The film will keep on developing until it is put into the fixer.

Question: How long should the film be left in the fixing solution?
Answer: The time is not critical and depends upon the age of the fixer. The film should remain in the fixer at least twice as long as it takes for all the milky appearance of the film to disappear. In warm climates, the film is left in the fixer about 1/2 hour to harden the emulsion.

Question: How long should the film be washed after removing it from the fixer?
Answer: At least 15 minutes in running water.

Question: What precautions should be taken in handling the film?
Answer: Hands should be dry and care must be taken not to rub or bend the film. Rubbing the film will put abrasion marks on the film, bending the film will desensitize the film and leave streaks or moon shaped areas.

Question: What are static marks?
Answer: Black marks on the film which resemble streaks of lightning caused by friction which generates static electricity. This is more prevalent in cold frosty weather.

Question: How can static marks be minimized?
Answer: Careful handling of the film to eliminate friction. A strip of metal molding on the front edge of the loading bench which in turn is grounded to a water pipe will sometimes carry off the static charge when the cassette touches the molding.

Question: What causes stains on the film?
Answer: Old worn out solutions or insufficient washing.

Question: What causes small round white spots on the film?
Answer: Air bubbles. This can be eliminated by raising and lowering the film several times when first put into the developer.

Question: Should the film be agitated while developing?
Answer: Yes. The film should be raised and lowered in the developer about every thirty seconds. This will bring in fresh developer to replace the exhausted developer which has been in contact with the film.

Question: Must films be protected from x-ray exposure while in the dark room?
Answer: Yes. Films or loaded cassettes should be stored in a metal protective chest. On some installations a sheet of 1/16 inch sheet lead is fastened to the wall between the film and the source of x-ray radiation. The films must be stored behind the lead when the x-ray equipment is in operation.

Question: Will it be detrimental if developer gets into the fixer or fixer into the developer?
Answer: Developer in the fixer is not detrimental unless the amount is excessive. However, it only takes a few drops of fixing solution to ruin the developer.

CONCLUSION

Ordinary care and attention to the many small details will improve your radiographic result and make diagnosis much easier.

TROUBLE CHART
DARK ROOM

CONDITION	CAUSE
Gray Films	1. Under developed. 2. Old developer. 3. Developer weakened by dilution. 4. Safe light fog. 5. Developer too cold. 6. Developer too hot.
Stains	1. Improper rinsing. 2. Improper washing. 3. Developer exhausted. 4. Developer contaminated. 5. Exhausted hypo.
Streaks	1. Developer not mixed completely. 2. Under developed. 3. Dirty hanger clips.
Static Marks	1. Rough handling of undeveloped films or cassettes. Friction.
Crescent Marks	1. Bending film while loading.
Frost like Appearance	1. Incomplete washing.
Corner Marks	1. Wet or dirty fingers. 2. Dirty hanger clips.
Blank or opaque areas	1. Films sticking together or to the side of the tank.
Light Spots	1. Fixer or water on film before development.
Dark Spots	1. Dust, liquid or powdered developer on film before development.
White Spots	1. Bubbles clinging to emulsion surface during development. 2. Dry hypo on wet film while drying.
Lack of Contrast	1. Under developed. 2. Cold developer. 3. Exhausted developer.
Multiple White Specks	1. Dirty Screens. 2. Barium on cassettes, sheets or table top.

IMPROVING THE RADIOGRAPH

Question: How can I improve detail or sharpness of the radiographic image?

Answer: Do everything possible to stop motion. Compression bands as a rule are not desirable as they cause distortion of the spine. However, a head clamp will eliminate a great deal of motion without distorting the spine. Another factor that will improve detail is to increase the focal distance. This calls for an increase in the time factor. Refer to the change of distance table on all Fischer charts to determine how much time increase is required for any desired distance. The figures shown on the change of distance table are multiplying factors and should be used to multiply the time factor shown at the standard distance. (For example) If the regular technic on a pelvis calls for 25 MA, 5 seconds at 30 inches and it is desired to increase the distance to 36 inches to improve detail, find 30 inches in the left hand column of the change of distance table then read straight across to the 36 inch vertical column. Where the 30 inch horizontal line intersects the 36 inch vertical column will be found the figures 1.4. This is the multiplying factor required to obtain the same density at 36 inches that was obtained at 30 inches. Multiplying the time factor of 5 seconds for 30 inches by 1.4 gives us a time factor of 7 seconds for 36 inches. This added time will compensate for the increased distance and produce better detail than that obtained at 30 inches. Care must be taken to make sure that the increased time will not cause motion on the part of the patient.

Question: How can radiographic contrast be improved?

Answer: By contrast we mean the percentage difference between the blacks and whites on the film.

There are many factors that effect contrast. Unsafe dark room lights, light fog, x-ray fog, outdated film, worn out solutions, etc. (See questions and answers on dark room technic). Another factor that effects contrast is secondary radiation. Secondary radiation is created in the tissues and gives the appearance of a fog. The thicker the mass and the denser the mass being x-rayed, the greater the amount of secondary radiation generated. Secondary radiation can be reduced by using a cone that just covers the area that the operator wishes to show on the film. It is obvious that reducing the size of the port of entry by the use of a cone, that secondary radiation will not be generated in tissues surrounding the anatomical area under examination.

Another factor which effects secondary radiation is kilovoltage. The higher the voltage the more secondary radiation generated in the tissues. Thick masses of tissue usually call for higher kilovoltage. If the kilovoltage is reduced and the time increased to compensate for the reduced kilovoltage, much better contrast will be obtained on heavy patients. Referring to the relation of KVP to time of exposure table on all Fischer technic charts, lets assume that we want to reduce the kilovoltage 5 KVP to improve contrast. Under the column with the heading (Reduce KVP) find the figure 5. On the same line in the next column to the left under the heading (Increase Time) will be found the figures 1-1/2. This is the multiplying factor to be used to compensate for the reduction in voltage. For example - If the chart calls for 25 MA, 5 seconds and 70 KVP and we decide to reduce the KVP 5 KVP, it will be necessary to multiply the time factor of 5 seconds by 1-1/2 which gives us 7-1/2 seconds time. If we were to reduce the KVP 10 KVP according to the table, we would have to multiply the regular time factor by 2 which

would make our exposure 10 seconds instead of 5. If for any reason it was desired to increase the KVP in order to reduce time, the two columns on the left hand side of the table can be used. It will be noted that increasing the KVP 5 KVP will reduce the time to 3/4. If we increase the KVP 10 KVP the time can be cut in half.

Question: Is it necessary to make corrections in exposure time for patients of different ages?

Answer: Yes, in some cases. No change is necessary on patients between 14 and 55 years of age. Referring to the age correction table, it will be noted that on patients over 55 years of age, the KVP should be reduced 2 KVP or the exposure reduced to 80 per cent of normal. The table also shows the reduction necessary in patients of from 1 to 12 years of age. Use of this table will permit more uniform results.

SUMMARY

Better radiographs will be obtained by:
1- Making sure there is no motion on the part of the patient.
2- Making sure all your dark room factors are correct.
3- Reducing kilovoltage and increasing distance where greater time factor is practical.

Initial Anode-Film Distance	TO CHANGE FOCAL DISTANCE FACTORS							
20"	1.0	1.6	2.3	3.2	4.0	5.8	9.0	13.0
25"	.64	1.0	1.4	2.1	2.6	3.7	5.8	8.3
30"	.44	.69	1.0	1.4	1.8	2.6	4.0	5.8
36"	.31	.48	.69	1.0	1.2	1.8	2.8	4.0
40"	.25	.39	.56	.81	1.0	1.4	2.3	3.2
48"	.17	.27	.39	.59	.69	1.0	1.6	2.3
60"	.11	.17	.25	.36	.44	.64	1.0	1.4
72"	.08	.12	.17	.25	.31	.44	.69	1.0
New Anode-Film Distance	20"	25"	30"	36"	40"	48"	60"	72"

RELATION OF KVP TO TIME OF EXPOSURE			
REDUCE TIME	ADD KVP.	INCREASE TIME	REDUCE KVP.
TO 3/4	5	TO 1-1/2	5
2/3	8	2	10
1/2	10	2-1/2	12
3/5	12	3	13
1/3	13	4	16
1/4	16	4-1/2	17
1/5	18	5	18

AGE CORRECTION		
BY EXPOSURE OR KILO-VOLTS		
PER-CENT EXPOSURE	AGE	REDUCE K.V.P.
100%	14 to 55	0 K.V.
90%	12 Years	1 K.V.
82%	10 Years	2 K.V.
72%	8 Years	3 K.V.
64%	6 Years	4 K.V.
56%	4 Years	6 K.V.
48%	2 Years	8 K.V.
44%	1 Year	9 K.V.
Over 55 Years Employ 80% or -2 K.V. less.		

For an explanation of the above tables refer to article on improving the Radiograph.

QUESTIONS AND ANSWERS ON THE USE AND CARE OF INTENSIFYING SCREENS AND CASSETTES

Question: What are intensifying screens?
Answer: Intensifying screens are made with a cardboard base and coated with a fluorescent material which emits visible light when excited by x-ray radiation.

Question: How are intensifying screens used in radiographic work?
Answer: The intensifying screens are mounted in a light proof holder called a cassette. The film is loaded in the cassette in a dark room. Both fluorescent surfaces of the screens are in direct contact with the film.

Question: Just what happens when x-radiation strikes the screens?
Answer: The screens fluoresce with visible light in direct proportion to the amount of x-ray radiation striking the screens. The result is that the film is not only exposed with x-ray but is exposed with visible light.

Question: What is the advantage of this?
Answer: It permits a much shorter exposure time.

Question: What is the intensifying factor when using intensifying screens?
Answer: The intensifying factor will vary with the kilovoltage. On an average it will be about 40 to 1.

Question: What percentage of the exposure is made with x-ray and what percentage is made with visible light when using intensifying screens?
Answer: About 98 percent of the exposure is made with visible light and 2 percent with x-ray radiation.

Question: What advantage does the shorter exposure time give?
Answer: Eliminates movement by the patient and saves wear and tear on the x-ray tube and machine.

Question: What films should be used with intensifying screens?
Answer: Regular films.

Question: Why?
Answer: Regular films are very sensitive to the blue light emitted from the intensifying screens.

Question: Can non screen films be used with intensifying screens?
Answer: Not satisfactorily because non screen films are not sensitive to visible light.

Question: Are all screens the same speed?
Answer: No. Intensifying screens come in three different speeds. Slow or definition, medium speed and extra fast.

Question: What determines the speed of a screen?
Answer: The size of the crystals used. The larger the crystals the faster the screen,

Question: Do high speed screens give as good detail as slower screens?
Answer: No. The slower the screen, the better the detail. However, high speed screens as manufactured today give very satisfactory radiographs.

Question: What determines the selection of screens?
Answer: The power of the equipment. Generally high speed screens are used on equipment up to 100 milliampere capacity. Par-speed or medium speed screens are used on 200 or 250 milliampere machines except on full spine work taken at a 60 inch focal distance in which case, high speed screens should be used.

Question: What care should be taken with screens?
Answer: Screens should be inspected every week and all dust particles cleaned out with a camel hair brush. If screens are soiled, clean with a wad of cotton soaked in non-medicated grain alcohol or carbon tetrachloride. Developer stains cannot be removed. Cassette should always be closed when not in use.

Question: If the screens turn yellow will it effect the speed of the screen?
Answer: Yes. Screens should be discarded if they show a yellow tinge.

Question: How should a film be removed from the cassette?
Answer: After releasing the spring bars, turn cassette upside down and lift bakelite side of cassette up. Film will drop out. This eliminates digging the film out with the finger nails and possibly ruining the screen.

Question: What care should be given cassettes?
Answer: Cassettes should be handled carefully. Dropping the cassette on the floor will very likely spring the cassette and impair the contact. Examine the bakelite backs from time to time and note if there is any bulging of the bakelite. If bulging is apparent the chances are that poor screen contact is present with the consequent loss of detail.

July 6, 1949

QUESTIONS AND ANSWERS ON BUCKY DIAPHRAGMS AND STATIONARY GRIDS

Question - What is the purpose of a bucky diaphragm or stationary grid?
Answer - The purpose of a bucky diaphragm or stationary grid is to filter out secondary or scattered radiation which is generated in the tissues and tends to fog the radiograph.

Question - How does the filtering process function?
Answer - Both the bucky diaphragm and stationary grid, incorporate a grid which is made up of alternate strips of lead and wood set on edge. X-radiation traveling in straight lines will go through the grid while scattered or secondary radiation will strike the lead strips and be absorbed.

Question - What is the difference between a bucky diaphragm and a stationary grid?
Answer - A bucky diaphragm is equipped with a motor mechanism which moves the grid continuously across the film while the exposure is being made. This movement eliminates the shadow of the lead strips. In the case of a stationary grid, the grid does not move so consequently the lead strips show on all films.

Question - Is there any advantage in using a stationary grid instead of a bucky diaphragm?
Answer - None except lower cost and portability for bedside work.

Question - What determines the efficiency of a bucky or stationary grid?
Answer - The filter ratio. The higher the ratio the more secondary radiation filtered out.

Question - What determines the filter ratio?
Answer - The ratio between the thickness of the grid and distance between the lead strips. If the thickness of the grid is six times the distance between the lead strips it would have a 6 to 1 ratio.

Question - What is meant by a 50 or 16 line grid?
Answer - A 50 line grid means that there are 50 lead strips to the inch. A 16 line grid has 16 lead strips to the inch.

Question - Does a 50 line grid have any advantages over a 16 line grid?
Answer - Yes. A 50 line grid can be made much thinner and still maintain the same filter ratio. The thinner grid has less absorption.

Question - How should the bucky diaphragm be timed in relation to the x-ray exposure?
Answer - The timing on the bucky should be about 20% longer than the actual x-ray exposure.

Question - Are the timing scales on a bucky accurate?
Answer - The timing scales are usually quite accurate when the room temperature is around 70°. At higher temperatures they will be fast and at lower temperatures they will run slow. This is due to a change in the viscosity of the oil used in the cushion chamber which will vary with the temperature.

Question - What causes grid lines on the film when using a bucky?
Answer - Several things can cause grid lines.

1st. Uneven travel of the grid due to air in the oil chambers, low oil, sticky bearings or binding of the grid or grid mechanism or some adjacent part.
2nd. Ratio of grid travel to actual timing too great.
3rd. Grid timing too short. Grid timing should be about 20% greater than actual x-ray exposure.
4th. Tube not centered on the bucky.
5th. Too great or too little tube to grid distance. (focal distance)

Question - Is it possible for all technical factors to be correct and the bucky functioning perfectly and still show grid lines?
Answer - Yes. On self-rectified units certain grid timing and x-ray timer combinations

tions

will create a stroboscopic effect which will show grid lines even though all factors are perfect. The remedy is to change the timing of the bucky slightly.

Question - What is meant by focal distance on a bucky diaphragm or stationary grid?

Answer - The grids on a bucky and an aligned stationary grid are so designed that the lead strips are radial to focal spot of the x-ray tube at a specific tube to film distance.

Question - What focal distances are buckys built for?

Answer - Bucky diaphragms can be obtained in focal distances of 30 inches, 36 inches and 48 inches. Aligned stationary grids can be obtained in 30 and 36 inch focal distances.

Question - If a bucky or stationary grid is built for a certain focal distance does that mean that no other distance can be used?

Answer - No. A 30 inch bucky can be used at focal distances of from 25 inches to 40 inches. A 36 inch bucky can be used from 30 inches to 45 inches and a 48 inch bucky from 45 to 60 inches.

Question - Is there any difference in exposure time required if the focal distance is more or less than that which the bucky or grid was designed for?

Answer - Yes. A greater or shorter focal distance will increase the absorption in the grid and require a longer exposure time.

Question - Can a bucky designed for 48 inch focal distance be used at a 30 inch distance?

Answer - No. A 48 inch bucky cannot be used at less than 45 inches with satisfactory results.

Question - Are all stationary grids aligned?

Answer - No. Stationary grids come in both aligned and paralleled types.

Question - Has the aligned grid any advantage over the parallel grid?

Answer - Yes. Due to the fact that the aligned grid is focused for a specific focal distance it is more efficient.

Question - When is the parallel grid used?

Answer - For long distance work such as chest taken at 72 inches.

STEREOSCOPIC WORK
ON ALL T UNITS, MPA20 & MPA30
X-RAY UNITS

From time to time users and prospective customers of T Units, MPA20 and MPA30 Unit express the desire to make stereoscopic films. To make stereoscopic films of any anatomical region, it is necessary to make two films from different angles. The tube being shifted an equal distance each side of center to obtain the necessary angulation. The films must be changed without disturbing the patient which calls for the use of a cassette tunnel or Bucky diaphragm.

Due to the fact that the cone port on the T Units, MPA20 or MPA30 is 1-1/2" off center of the head, a 3" stereoscopic lateral shift can be obtained by manipulating the head in a fashion that will permit making two radiographs at different angles. The following sketches along with a step by step description of the head manipulation will allow the operator to make the necessary stereoscopic shift quickly and easily.

No. 1 Center head (not cone port) on center of Bucky or film tunnel. The Allen set screw holding the tube head in the yoke can be used as a centering point. Centering the head as described automatically placed the cone port 1-1/2" off center (see Fig.1). This is the position for the 1st stereoscopic film.

No. 2 After changing films without disturbing the patient, rotate tube head in the yoke 180° or so that tube port points up or away from the table. (See Fig.2)

No. 3 Rotate tube on its horizontal Axis or cross arm 180° so that cone port points down or towards the table. This automatically places cone port 1-1/2" the other side of center, making a total shift of 3". (See Fig. 3).

Fig. - 1

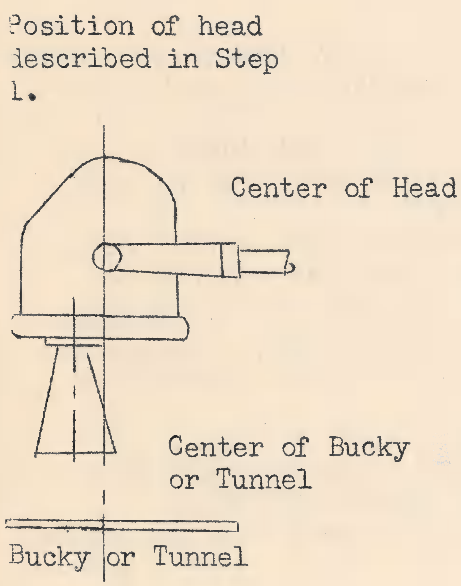


Fig. - 2

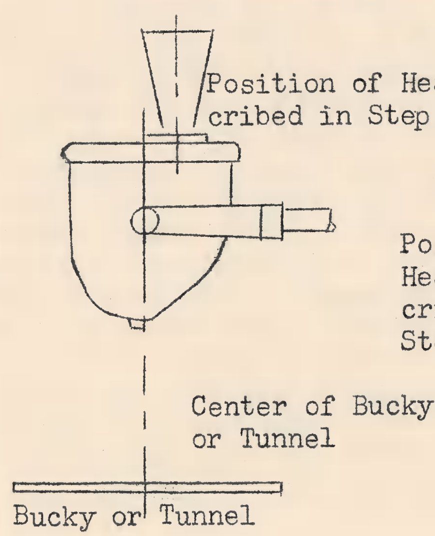
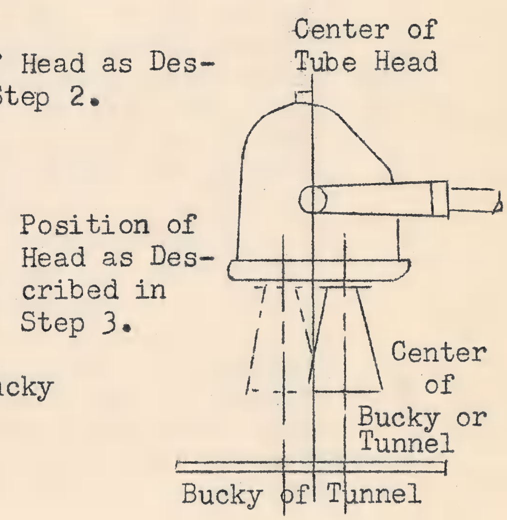


Fig. - 3

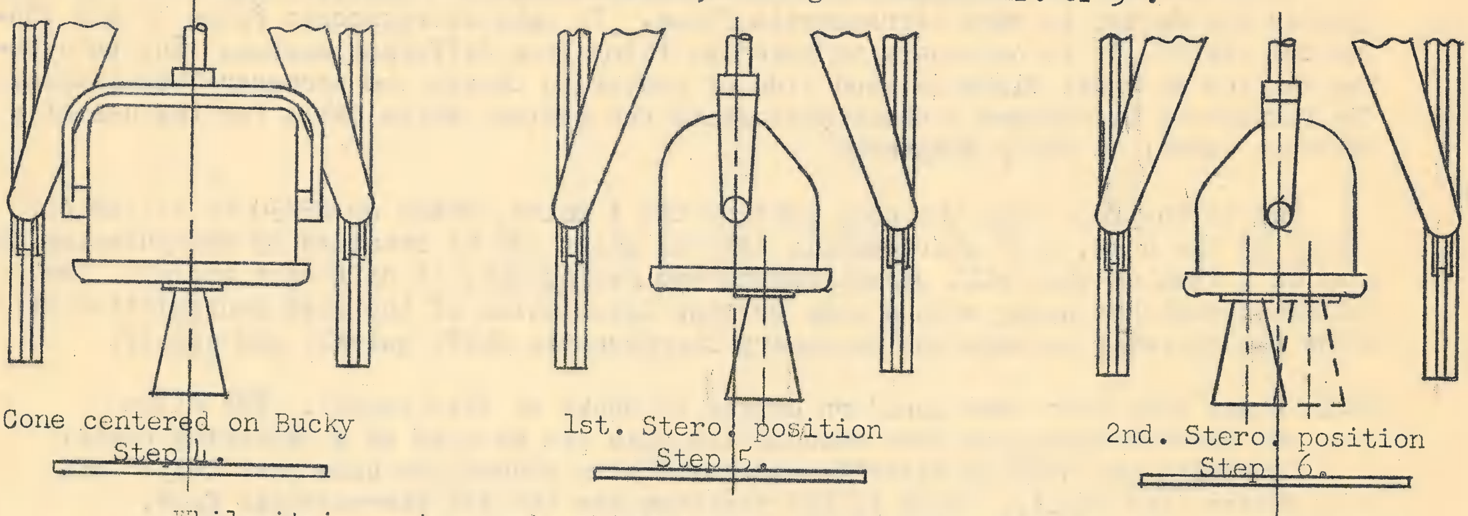


When the T Unit is mounted on rails such as is the case when using a vertical Bucky a stereoscopic shift can be made by following the step by step instructions below:

No. 1 Mount rails and Bucky so cone port centers on Bucky when head is in the position shown in Fig. 4. With the tube head in this position non-stereoscopic films can be made with the tube centered on the Bucky.

No. 2 Make 1st film by rotating tube head 90° on horizontal axis or cross arm, placing head in position shown in Fig. 5. This places cone port 1-1/2" to one side of center.

No. 3 After changing films, rotate tube head 180° on horizontal axis or cross arm placing tube head in position shown in Fig. 6. This places tube head 1-1/2" the other side of center, making a total shift of 3".



Cone centered on Bucky
Step 4.

1st. Stero. position
Step 5.

2nd. Stero. position
Step 6.

While it is customary to shift the tube 10% of the focal distance, this shift is not critical. The 3" shift obtained on the TC,MP 10 and 20 can be used on any focal distance of from 25 to 42".

It will be found that with a little practice, a stereoscopic shift as described above can be made very quickly and with ease.

RULES FOR STEREOSCOPIC FILMS

1 - Patients position must not be disturbed during the entire process of making the two films. Use a cassette tunnel or Bucky diaphragm which will permit changing films without moving the patient.
2 - Place second film in exactly the same position as the first film.
3 - It is not necessary to tilt tube head to focus on the center of the film unless cone used is small enough to cause cut off.
4 - Stereoscopic shift must always be made across the long bones of the body.
5 - The stereoscopic shift on chest should always be made across the ribs.
6 - Stereoscopic films on chest made with a manual shift and manual changing of the films is very unsatisfactory as both films must be taken on a single inhalation. Stereoscopic chest work calls for an automatic stereo shift and an automatic cassette shifter.
7 - Stereoscopic films should have the same density.
8 - In order to see stereoscopically, it is necessary to have eyesight in both eyes. Some people with good eyesight cannot see stereoscopically.
9 - Films must be placed in stereoscope properly in order to obtain the proper perception.

NOTE:

The above method and procedure applies to any self contained head having an off set cone port.

BULLETIN

X-RAY PROTECTION AT THE TUBE HEAD

We are all aware of the dangers of x-ray radiation both to the operator and the patient. With modern day equipment, screens and films, the amount of exposure received by the patient is relatively small compared to the total amount of radiation that can be tolerated. The chief danger from the standpoint of the patient is repeated exposures or prolonged fluoroscopic examinations. However, x-ray exposure to the operator is a different story.

Due to the fact that x-ray exposure is accumulative and a tolerance is never established, such as in the case of sunburn, it is vitally essential that every precaution be taken to protect the operator who is exposed to small amounts of radiation day after day, which cannot be measured.

From the foregoing it is obvious that every effort must be made to eliminate all stray radiation from the tubehead and confine the x-ray beam so that only the radiation used in making the radiograph or fluoroscopic examination emanates from the tubehead.

All x-ray manufacturers attempt to build into their tubeheads some sort of x-ray protection. The method many competitors use, is to build into their equipment just enough protection to get by, or in other words, what they think is good enough. The other method, THE FISCHER WAY, is to build into every tubehead x-ray protection in accordance with the Bureau of Standards specifications.

This is an unseen and costly feature on FISCHER-built x-ray apparatus and the doctor or hospital can only become aware of this added value by having the FISCHER representative explain in detail the effort and expense the Company puts forth to give the operator adequate x-ray protection.

DESCRIPTION AND USE OF THE FISCHER ALIGNING CONE

In many types of x-ray work it is essential that the central ray emanating from the x-ray tube be directed accurately through certain anatomical parts in order to show the part clearly on the film without distortion or super-imposition. This is particularly true where it is necessary to angulate the x-ray tube, such as in cervical spine and sinus work.

In the past, aligning the central ray of the tube with the anatomical part has been done largely by guess work, using the eye to line up the central ray with the part. This was very inaccurate and the results very undependable.

Using the aligning cone is a very simple procedure where the machine is operated on properly placed tracks. The hole in the base of the cone in which the cord is attached should be on the operating side of the head, 90° from the perpendicular. To trace the course of the central ray from the source at the x-ray tube to the spot on the film where it will terminate, it is only necessary to line up the cord attached to the cone base with the aligning indicator on the cone proper and then stretch the cord to the spot on the bucky where the central ray will strike. Angulating the tube, adjusting the tube height and bucky height as well as angulating the patient's head is then a simple procedure. The aligning cord will also show just what anatomical structures the central ray will transverse.

In addition to the above, rotating the cone 90° so that the aligning cord and indicator are on top of the cone will permit accurate centering of the tube on the bucky in installations where mobile units not on tracks are used.

The above item is cataloged as follows:

Aligning Cone for use with any x-ray machine presently manufactured by us. Same as Cone "C" (Cat. No. 4736) except that it has aligning feature. When used with the Model TF our Cat. No. 4742 Adapter must be ordered additionally.

H. G. FISCHER & CO.

PERTINENT FACTS REGARDING X-RAY TUBES

X-ray tubes are extremely fragile and should be handled with extreme care if long tube life is to be expected. X-ray tubes can be ruined in a few seconds if the capacity of the tube is exceeded. However, if the x-ray tube has reasonable care and use, many thousands of exposures can be made during the course of its normal life.

Overloading of the tube more often results from testing for the correct milliamperage than from actual radiographic exposures. Machines designed with automatic preselection of milliamperes and machines equipped with preset devices greatly reduce the possibility of overloading the tube.

In the absence of automatic preselection and preset devices, overloading of the tube while testing can be reduced by testing the milliamperes at a voltage 10 to 20 KVP below the voltage to be used in the exposure. Start with lower filament current and increase it for successive test exposures until the desired milliamperes is obtained.

New tubes should be seasoned before operating. For seasoning a tube, use 5 MA - 85 KV - 20 to 30 seconds. This seasoning process will warm up the metal parts of the tube and absorb any slight amount of gas that may be present.

Preliminary warming of a cold tube before a short but heavy exposure will do much to conserve tube life. This is only necessary when high milliamperage values are used. (Any MA value over 50 MA is considered a high MA value). For warming a tube a load of 10 MA - 85 KVP - 10 seconds should be used. It is not necessary to prewarm the tube if it has been used within the past hour.

Longer tube life will result if care is used in turning off the machine between exposures. Any oil leak in the tube housing should be reported to the service man at once as low oil might cause a spark over inside the housing and puncture the tube.

A careful study of the loading charts furnished with the tube should be made and the values never exceeded. In reading the loading chart, the maximum time of exposure will be found by following the horizontal voltage line to its intersection with the diagonal milliampere line and then dropping vertically down to the base time line.

Better detail will be obtained by using the fine focus of the tube if the unit incorporates a double focus tube. However, if the time factor used is excessively high, there is a chance for motion which will defeat the advantage of the finer focal spot. All anatomical parts such as chest and stomach should be taken with the large focus to eliminate movement caused by involuntary motion. Long distance work such as full spines should be taken with the large focus to reduce time of exposure and eliminate motion. The increased focal distance compensates for the larger focal spot.

THE IMPORTANCE OF ADEQUATE POWER SUPPLY FOR X-RAY INSTALLATIONS

Occasionally we receive letters of complaint from doctors stating that their X-Ray installation is not producing the quality of radiographic work expected or desired.

There are many reasons why satisfactory results are not obtained, such as poor dark room technic, slow films, worn out screens, ect. This phase of the situation will be covered in another bulletin.

We have found that in many cases, the difficulty is due to inadequate power supply. If the line wires are too small for the load or the pole transformer is not large enough, there will be an excessive drop in voltage when the x-ray load is thrown on the line. This in turn causes a drop in KVP on the tube. The doctor might have the controls set for a given KVP (for instance) 85 KVP - 100 MA. However, due to excessive line drop he is perhaps only obtaining 75 KVP when the x-ray load is thrown on the line. This naturally causes a light film which can only be corrected by adding time or KVP.

Another factor that enters into the picture when excessive line drop is present, is that the inverse voltage increases tremendously causing added stress on cables, tube and transformer insulation. Many of the punctured cables are no doubt due to high inverse voltage caused by excessive line drop.

The attached wiring table indicates the size wire and transformer capacity required for all Fischer machines necessary to obtain satisfactory operation. The wire and transformer sizes indicated, are figured to give a line drop of not more than 3%.

NOTE: IF WIRE SIZE INDICATED IS NOT AVAILABLE, USE NEXT LARGER SIZE.

WIRING SPECIFICATIONS

TC 30 - TF 30 - DELUXE TC 30
Operating on 220V - 60 Cy

DISTANCE FEET	- 50'	75'	100'	150'	200'	250'	300'	350'	400'
WIRE SIZE NO.	- 12	10	10	8	8	6	6	4	4
CUT OUT BOX	- 30 AMP.								
FUSES	- 30 AMP.								
AMPERES	- 25 AMP.								

TC 30 - TF 30 - DELUXE TC 30
Operating on 110V - 60 Cy

DISTANCE FEET	- 50'	75'	100'	150'	200'	250'	300'	350'	400'
WIRE SIZE NO.	- 8	6	4	2	2	1	1/0	2/0	2/0
CUT OUT BOX	- 60 AMP.								
FUSES	- 60 AMP.								
AMPERES	- 50 AMP.								

TC 50 - TF 50 - DELUXE TC 50
Operating on 220V - 60 Cy ONLY

DISTANCE FEET	- 50'	75'	100'	150'	200'	250'	300'	350'	400'
WIRE SIZE NO.	- 10	8	8	6	4	4	2	2	2
CUT OUT BOX	- 60 AMP.								
FUSES	- 60 AMP.								
AMPERES	- 50 AMP.								

DELUXE RF-100 and RF-100
Operating on 220V - 60 Cy ONLY

DISTANCE FEET	- 50'	75'	100'	150'	200'	250'	300'	350'	400'
WIRE SIZE NO.	- 8	6	6	4	2	2	1	1	1/0
CUT OUT BOX	- 100 AMP.								
FUSES	- 75 AMP.								
AMPERES	- 75 AMP.								

DELUXE RF-250 Operating on 220V - 60 Cy. ONLY

DISTANCE FEET	- 50'	75'	100'	150'	200'	250'	300'	350'	400'
WIRE SIZE NO.	- 8	6	4	2	2	1	1/0	2/0	2/0
CUT OUT BOX	- 100 AMP.								
FUSES	- 100 AMP.								
AMPERES	- 100 AMP.								

February 23, 1950

MILLIAMPERE PRE-ADJUSTMENT SWITCH ASSEMBLY

Experience has proven that more X-Ray tubes are damaged in testing the tube for proper milliampere values than in actual radiographic exposure. This is particularly true when using high milliampere values, such as used in chest or gastrointestinal work where high milliampere values and short exposure time is necessary. In the case of a chest radiograph, the time of exposure is only 1/10 or possibly 2/10 of a second. However, if the control is adjusted to the proper milliampere value by actually passing high tension current through the tube, a minimum of 1 second is consumed in testing, as it takes that long for the milliampere meter to register the correct value. The chances are that this one-second test exposure will be made two or three times before the milliampere factor is adjusted correctly.

All time consumed in testing the X-Ray tube for correct milliamperage must be computed in the loading limit of the tube. It is easily possible for an operator to load the X-Ray tube to the limit just testing and then overload the tube when making a very short exposure, although the actual radiographic exposure is well within the load limit of the tube. So much time has been used in testing that the short radiographic exposure used is enough to exceed the heat storage limit of the X-Ray tube and tube damage results.

Fischer X-Ray apparatus, when equipped with the milliampere pre-adjustment switch, eliminates the necessity of passing high voltage through the X-Ray tube when testing the tube for correct milliampere values, thus saving wear and tear on the X-Ray tube with resulting tube economy.

To use the milliampere pre-adjustment switch, it is necessary to calibrate the unit at the time of installation. Assuming that the unit being calibrated is a 50 MA TC, which has kilovoltage scales for 10, 30, 40 and 50 MA, all four milliampere values are to be calibrated. On the blank chart furnished with all machines with preadjustment switches, (see sample below) enter in the blank squares on the milliampere line of the chart the milliampere values to be calibrated, which in the case of the TC 50 will be 10, 30, 40 and 50.

MILLIAMPERE PRE-ADJUSTMENT FOR

"T" Models 50-96

MILLIAMPERES										
PRE-ADJUSTMENT READING										

1st. Adjust the kilovoltage for approximately 50 KV.

2nd. With the timer switch on the test position, depress the timer push button and adjust the main and auxiliary milliampere controls until milliampere meter reads 10 MA.

3rd. Release timer push button and depress pre-adjustment switch located on top of control. Note meter reading on red scale which is the top scale on the meter. Record this reading on the calibration chart under 10 MA and on the pre-adjustment line.

4th. Repeat for 30, 40 and 50 milliamperes and record the readings obtained on the red scale under the proper milliampere value on the calibration chart.

NOTE: The red pre-adjustment scale on the kilovolt meter is not calibrated in milliamperes but is an arbitrary scale and bears no direct relation to the actual milliampere values. Upon calibrating the unit, it might be found that 30 milliamperes are obtained when the meter reads 22 on the pre-adjustment scale. At any future time 30 milliamperes can be obtained by depressing the pre-adjustment switch and adjusting the main and auxiliary milliampere controls until the meter reads 22 on the red pre-adjustment scale. No actual high tension current is passing through the tube.

It is obvious from the foregoing that there is a distinct advantage, when using high milliamperage, in being able to pre-adjust the milliampere values without actually passing high voltage through the tube. With the idea in mind that greater tube economy will be forthcoming if a pre-adjustment device is used, it has been decided to incorporate the pre-adjustment device in all 50 milliampere units as standard equipment.

The following x-ray units of H. G. Fischer & Co. manufacture will have incorporated in them, without extra charge, a Pre-adjustment Switch Assembly:

Cat. No.	
5137R	TCR-50 Milliampere X-ray Unit on Rails
5137R-L	Same as Cat. 5137R but with longer upright
5138	Deluxe Rail Mounted TC-50 Milliampere X-ray Unit
5136	TC-50 Milliampere Mobile X-ray Unit
5137	TC-50 Milliampere Rail Mounted X-ray Unit
5149	TF-50 Milliampere X-ray Unit
5185	Spacesaver 50 Radiographic-Fluoroscopic Unit and Examining Table

The Fischer Model RF-100 Milliampere Shockproof X-ray Apparatus with Standard Control and the Fischer Model L-200 X-ray Apparatus incorporate a Pre-adjustment Switch that differs somewhat from the Pre-adjustment arrangement on our "T" Units.

The Fischer De Luxe RF-100 Milliampere X-ray Apparatus and the Fischer De Luxe RF-250 Milliampere X-ray Apparatus do not require a Pre-adjustment arrangement since the automatic controls of these units eliminate the necessity for this device.

GENERAL INFORMATION

PATIENT COMFORT

Every effort should be made to make the patient as comfortable as possible. All equipment adjustments possible should be made before the patient is placed on the table. The longer the patient is on the table the greater the chances are for motion. When radiographing extremities, the use of sandbags will help in eliminating motion.

VARIATIONS IN TECHNIC

All technic charts are made up for average patients. Muscular patients require 20% to 30% more exposure. Soft, flabby patients require about 20% less exposure.

MEASURING THE PATIENT

The patient should always be measured in the position that the radiograph is to be taken. If the patient is to be radiographed in the horizontal position, that is the position in which the patient should be measured. If the patient is to be radiographed in the standing position, the patient should be measured in the standing position. Always make sure that the caliper just lightly touches the patient on both sides and measurement is made at the thickest part of the area to be radiographed.

AGE CORRECTION

Patients between the ages of 14 and 55 years normally have tissues of the same densities and standard technic can be employed. Patients over 55 years of age usually have a lower bone calcium and for that reason the kilovoltage should be reduced 2 kilovolts or the time reduced 20%. Patients between the ages of 1 and 14 years require less exposure, depending upon the age. By referring to the age correction table on the technic chart, the necessary correction in exposure or kilovoltage can be made for any age from 1 to 14 years.

THE USE OF CONES

Few operators realize the importance of cones when doing radiographic work. The cone used for any radiograph should be just large enough to cover the anatomical area under examination. Using a cone just large enough to cover the desired area will reduce secondary radiation from surrounding tissues and produce a radiograph with much more contrast. Most charts furnished with x-ray units indicate what cone to use for each anatomical part.

FLUOROSCOPY

Before attempting to do fluoroscopic work, carefully read the section on fluoroscopy. Care should be exercised to make sure that the fluoroscopic shutters are in the open position when doing radiographic work. An arrow on the fluoroscopic shutter control casting indicates the direction the shutters are to be moved for the open position.

DARK ROOM

90% of radiographic failures are due to dark room difficulties. Careful study of the section on dark room technic will reduce radiographic failures to a minimum.

NON BUCKY TECHNIC

Should it be desired to dispense with the use of a bucky diaphragm or stationary grid and use only a cassette equipped with hi-speed screens, comparative densities can be obtained by reducing the kilovoltage 13 kilovolts below that shown for the thickness of the part or use 1/3 of the time indicated when using a bucky diaphragm. Better results will be obtained if the kilovoltage is reduced and the time factor remains the same as indicated for bucky technic.

POSITIONING INFORMATION

Depth measurement - The measurement in centimeters for any particular structure should be along the line of central ray projection.

Chest AP - Measure at plane between 5th and 6th dorsal and approximately 3 to 5 c.m. one side of the spine medium line. Chest should be taken in the standing position using a wall mounted cassette holder. Place back of hands on patient's hips. Bend elbows out to permit shoulders to come as close to the film as possible. Center tube at 5th or 6th dorsal.

Chest LATERAL - Measure patient with arms down, sliding centimeter caliper between arms and patient's body. Make measurement on a line with lower margin of scapula. Patient's arms are then raised above head. Center tube on line of measurement.

A.P. Lumbar-Pelvis - Caliper at point $2\frac{1}{2}$" below sternum as a measure of both full kidney and urinary tract and full lumbar and pelvis. For spine and bone work, the entire portion of the body between a point $2\frac{1}{2}$" below sternum through the first two-thirds of the femur may be considered lumbar pelvic grouping. The lower third of the femur takes the extremity grouping. Center tube at 3rd or 4th lumbar.

Lumbar and Sacrum LATERAL - For lateral lumbar spine center spine with center of table. Measure $1\frac{1}{2}$" above crest of ilium and center tube at that point.

Cervical Spine A.P. and LATERAL - Measure in plane of cervical dorsal junction.

LATERAL Sinus - Measure across forehead approximately on line drawn between frontozygomatic sutures and center one-half way along line between external meatus and outer canthus.

Frontal Sinus P.A. - Place patient face down on table. Have nose and forehead touching table top. Tilt x-ray tube 12° towards the feet. Direct central ray to center of film.

Maxillary Sinus - Patient in prone position. With full weight of head resting on the chin, the head is tilted until a line between the external meatus and the outer canthus of the eye forms an angle of 37° with the table top. X-ray tube is not angled. Direct central ray to center of film.

Sphenoid Sinus, Open Mouth - Patient in prone position. Head resting on chin and nose with mouth open. Tilt tube 20° towards patient's feet. Central ray should pass half way between upper and lower lips when mouth is open.

Mastoid LATERAL - Patient is placed in prone position. Permit head to assume a natural position, with the weight on the cheek. Tilt tube 15° toward patient's feet. Center $1\frac{1}{2}$" above and $1\frac{1}{2}$" behind the tip of the ear. When possible, fold ear forward.

Sternum Oblique - Place patient in prone position. Rotate patient slightly to eliminate superimposition of spine over sternum.

Atlas and Axis - Patient is placed on the table in the supine position with the median line of the body over the center line of the table. The chin is elevated until the occlusal surface of the teeth is vertical with the table top. With the mouth wide open, the film is entered half way between upper and lower lip. The central ray is directed to the center of the film.

Wrist P.A. - The forearm is placed on the table top with the palmar surface down. The wrist is centered to the film by placing the midpoint between the styloid processes over the center of the film. Direct central ray to center of film.

Wrist LATERAL - Place styloid process of the ulna over center of the film. Direct central ray to center of film.

Elbow LATERAL - When possible the arm is flexed to approximately 45° angle. The hand is turned sideways with thumb up. The medial epicondyle is centered on the film. Direct central ray to center of the film.

Elbow A.P. - The back of the arm and forearm are placed on film holder. The mid-point between the epicondyles is placed in the center of the film. Direct central ray to film. Place a sandbag in patient's hand.

Shoulder A.P. - Patient in supine position. Elevate opposite shoulder with sandbags or pillow to bring shoulder to be radiographed closer to film. Arm is abducted with palmar surface of hand upward. Place sandbag in patient's hand.

Foot A.P. - Patient may lie or sit on table with knee flexed at an acute angle, the plantar surface of the foot resting on film holder. The proximal end of the second metatarsal is centered to the film. Tilt tube 15° towards patient's head and direct central ray to center of film.

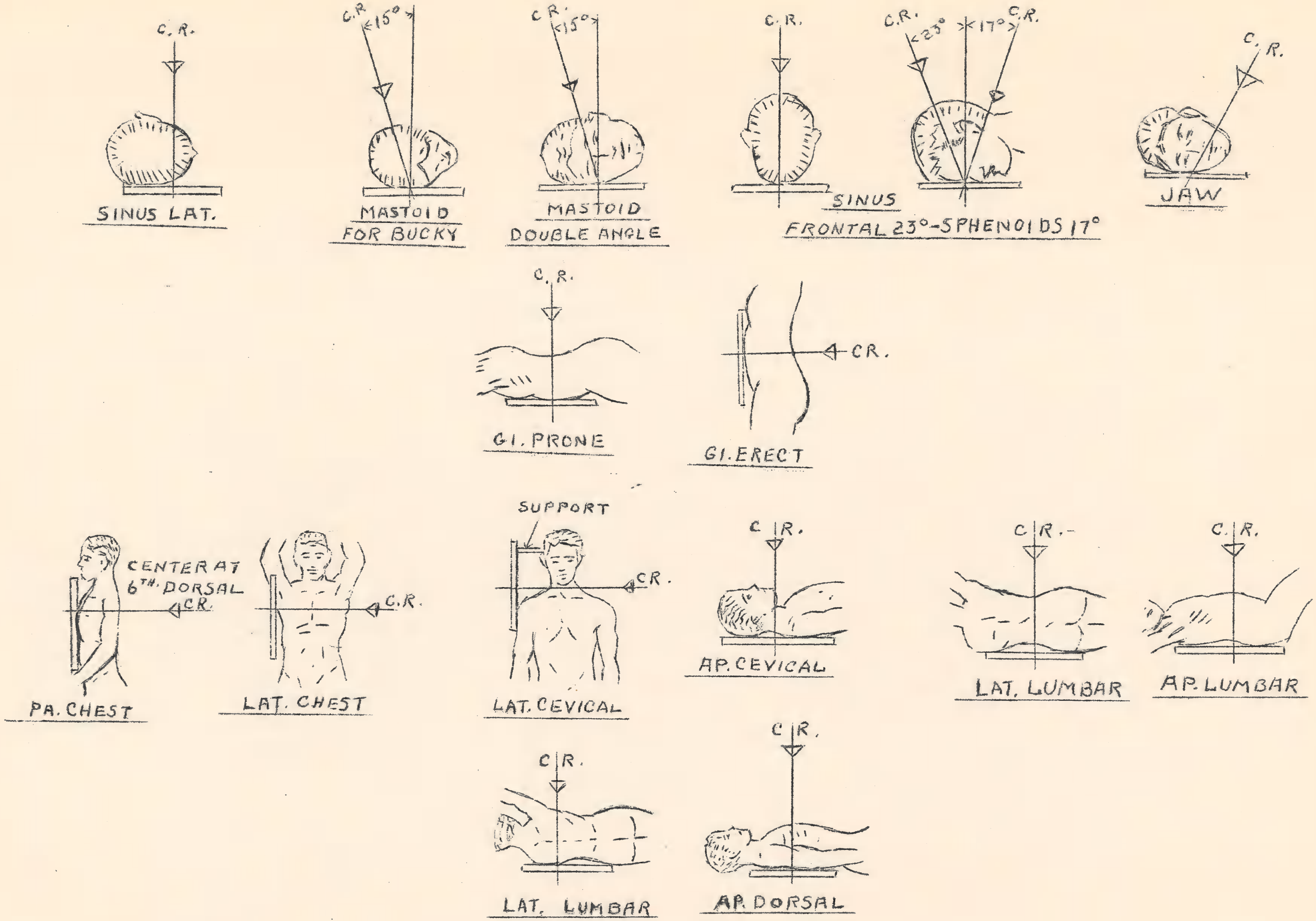
Foot LATERAL - Patient is placed in the lateral position with leg slightly flexed and supported by sandbags at knee. A point approximately 1/2 the distance from the great toe to the heel is centered on the film. Direct central ray to center of film.

Ankle A.P. - Place patient in the supine position with heel resting on film holder. Place sandbag under knee. The lower tip of the internal malleolus is centered on the film. Direct central ray to center of film.

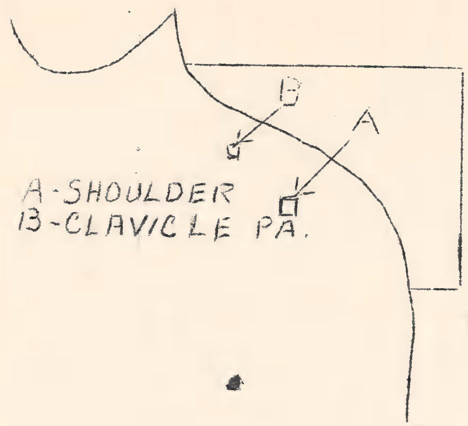
Ankle LATERAL - Place patient in lateral position. The ankle is placed on the film with the external malleolis on the film. The opposite leg is crossed over. The lower tip of the external malleolis is centered on the film. Direct central ray to center of film.

Knee LATERAL - Place patient on table with affected knee resting on film. Center lower margin of patella on center of film. Direct central ray to center of film.

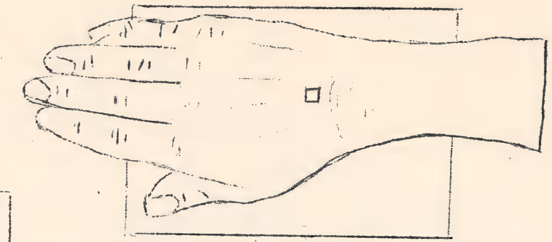
Knee P.A. - Place patient in prone position. Place sandbags under ankles to support toes. Lower margin of patella is placed in center of film. Direct central ray to center of film.



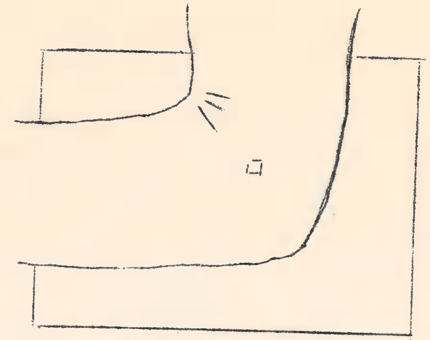
C. R.
SINUS LAT.
C.R. 15°
MASTOID FOR BUCKY
C.R. 15°
MASTOID DOUBLE ANGLE
C. R.
C.R. 23° 17° C.R.
SINUS
FRONTAL 23°-SPHENOIDS 17°
C. R.
JAW
C. R.
GI. PRONE
CR.
GI. ERECT
CENTER AT
6TH. DORSAL
CR.
PA. CHEST
C.R.
LAT. CHEST
SUPPORT
CR.
LAT. CEVICAL
C R.
AP. CEVICAL
C R.
LAT. LUMBAR
C. R.
AP. LUMBAR
C R.
LAT. LUMBAR
C R.
AP. DORSAL



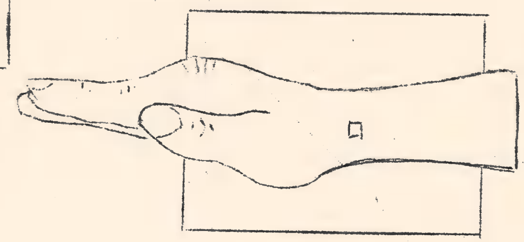
A-SHOULDER
B-CLAVICLE PA.



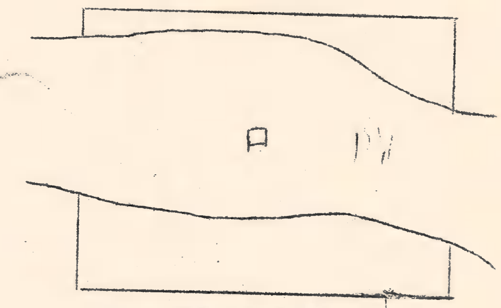
HAND PA.



ELBOW LAT.

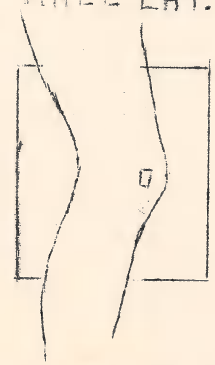


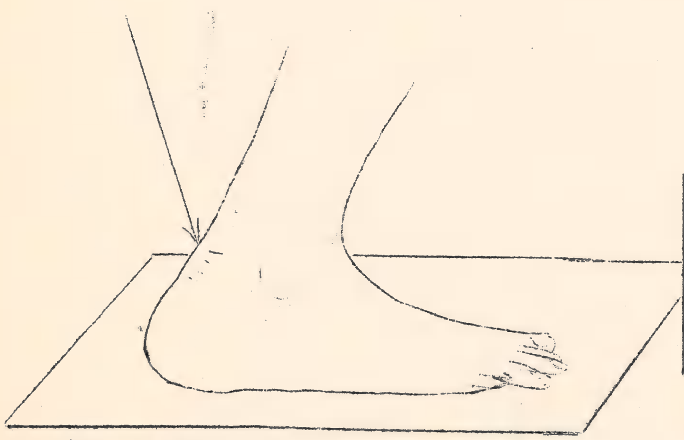
WRIST LAT.



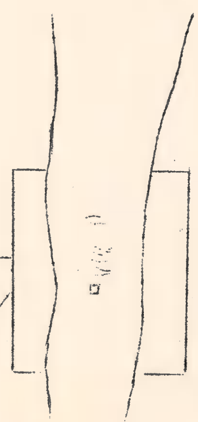
ELBOW AP.

KNEE LAT.



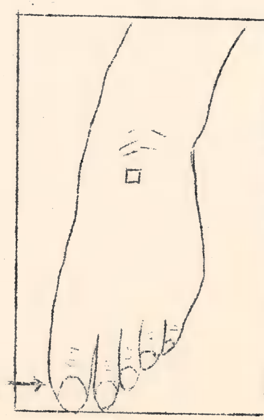


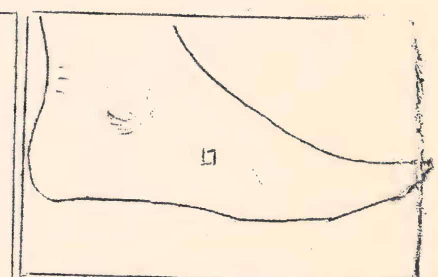
OS-CALCIS



KNEE AP.

FOOT AP.





FOOT LAT.

adjusted for that particular thickness of tissue. As each centimeter of tissue requires a change of 2 kilovolts, it is obvious that x-ray controls with 9 to 15 steps of control are not adequate as each step of voltage control represents kilovoltage jumps of 5 to 8 kilovolts. With coarse voltage steps as described, it is impossible to accurately adjust the kilovoltage for the thickness of part. The only alternative is to compensate with time for the discrepancy in voltage which necessitates that the operator resort to hunch or guesswork. It requires years of experience to become a good hunch technician.

Question: What is meant by specialized equipment?

Answer: Many manufacturers have one standard design and try, by making a few minor changes to adapt this design to all types of x-ray work. This has proven to be very unsatisfactory. H.G. Fischer & Co. have always built special equipment for the particular specialty. In designing equipment for any special radiographic work, every attempt is made to consult with outstanding men in the profession in order to give the user the ultimate in efficiency.

Question: What about price?

Answer: Price is important but not paramount. All equipment of quality must bear a price in proportion to the skill, time, experience and work attending their creation and manufacture. Things called expensive when justly estimated are usually the cheapest. Equipment built for cheapness and not for excellence of workmanship and end results is the most frequent and certain cause for dissatisfaction on the part of the customer.

Question: When comparing prices, what should be considered?

Answer: 1 - Does the price quoted include installation by a competent service representative?
2 - Does the price quoted include complete technical instructions by a trained company representative?
3 - Does the manufacturer have an advertised sales price or does the dealer charge any price he may see fit?
4 - Is the trade-in allowance fair or is the dealer boosting the list price in order to allow a greater trade-in allowance?
5 - What accessories are included in the sales price? Are such items as foot switch, cone, filter, timer, stabilizer etc. charged as extras in order to bring the base price down?
6 - What assurance do I have of service after the installation is made?
7 - Is the Company reliable?
8 - How long has the Company been in business?
9 - Will I be able to get service 10 years from now?

The above factors should be given the most serious consideration when contemplating the purchase of equipment. H. G. Fischer & Co. build equipment to fit every price range and every radiographic and fluoroscopic need and is backed up by 39 years of manufacturing know how.

TECHNIC CHART
(Use of)

The x-ray technic chart enclosed in this manual is one made up for a Fischer De Luxe 100 X-ray Unit. However, this chart can be adapted to any machine up to and including 100 milliamperes in capacity. For instance, if the machine you desire to use has a capacity of 25 milliamperes employ the time factors shown in the 25 milliampere column and the voltage technic shown on the left hand side of the chart which will give the desired density for the screens and films you are using. If the machine has a capacity of 50 milliamperes employ the time factors shown in the 50 milliampere column. In other words use the time factors shown in the milliampere column corresponding to the milliampere capacity of your machine. The kilovoltage will be the same regardless of what milliampere factor is used. On x-ray units of 100 milliamperes or less high speed screens should be used. Ordinarily the voltage technic shown in voltage technic #2 will give proper density. However, if the screens are old or slow it may be necessary to employ voltage technic #3 or possibly #4 to secure the proper density.

Initial Anode-Film Distance	To Change Focal Distance Factors							
20"	1.0	1.6	2.3	3.2	4.0	5.8	9.0	13.0
25"	.64	1.0	1.4	2.1	2.6	3.7	5.8	8.3
30"	.44	.69	1.0	1.4	1.8	2.6	4.0	5.8
36"	.31	.48	.69	1.0	1.2	1.8	2.8	4.0
40"	.25	.39	.56	.81	1.0	1.4	2.3	3.2
48"	.17	.27	.39	.59	.69	1.0	1.6	2.3
60"	.11	.17	.25	.36	.44	.64	1.0	1.4
72"	.08	.12	.17	.25	.31	.44	.69	1.0
New Anode-Film Distance	20"	25"	30"	36"	40"	48"	60"	72"

S